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ABSTRACT

Mildly mentally retarded (N=36), moderately mentally retarded (N=39), and normal (N=37) adolescents were compared on measures of sensorimotor learning ability to determine whether retarded adolescents can learn to perform a vocationally meaningful task as efficiently as normal adolescents. Three measures of sensorimotor learning ability were computed for each S: (1) inferred initial performance, (2) sensorimotor learning rate, and (3) predicted training time. Data were collected on the Salvendy One-Hole Test, a peg positioning task. Results indicated that mentally retarded and normal Ss had different sensorimotor learning abilities on two of three components of the learning curve model of sensorimotor learning ability. Retarded Ss had significantly lower inferred initial performance scores and longer predicted training time than normal Ss. However, retarded Ss were not found to have a different sensorimotor learning rate, suggesting that they may be able to learn a predominantly sensorimotor job (one relatively free of cognitive elements) as rapidly as normal Ss. (CL)

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COMPARISON OF SENSORIMOTOR LEARNING OF MENTALLY RETARDED AND NORMAL ADOLESCENTS

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by
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Comparison of Sensorimotor Learning of Mentally Retarded and Normal Adolescents

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Problem

Many mentally retarded individuals may be failing to reach their vocational potential due to denial of the opportunity to train and compete for sensorimotor tasks (jobs) which may be well within their capability to learn. The literature suggests that mentally retarded people may possess a reasonable level of sensorimotor learning ability. Past research on the topic seems to have been beset by the lack of sophistication in the measurement of sensorimotor learning ability. This study utilized a special approach to measure sensorimotor learning ability in order to determine whether mentally retarded adolescents can learn to perform a simple sensorimotor task as efficiently as normal adolescents.

Purpose

The purpose of this study was to compare the sensorimotor learning abilities of mentally retarded and normal adolescents on measures that are vocationally meaningful. An incidental purpose of the research was to develop a model of sensorimotor learning ability that would permit the efficient and reliable measurement of sensorimotor learning ability.

Mental Retardation and Sensorimotor Abilities

A low level of sensorimotor abilities is often ascribed to the condition of mental retardation. Studies have shown correlation between these

two conditions. The mentally retarded have demonstrated low aptitude for motor tasks (Ismail & O'Dwyer, 1975). Slowness of sensorimotor learning is often attributed to the mentally retarded as an entire class (MacMillan, 1977). In addition, the sensorimotor achievement levels of mentally retarded subjects have been shown to be well below those of normal people (Londeree & Johnson, 1973). In general, mentally retarded persons are characterized as starting lower, learning slower, and achieving less in the performance of sensorimotor tasks than normal persons (Dunn, 1978).

It was hypothesized in this study that the mentally retarded subjects would be less able learners than the normal subjects on three sensorimotor learning variables. These variables are inferred initial performance, sensorimotor learning rate, and predicted training time.

Subjects

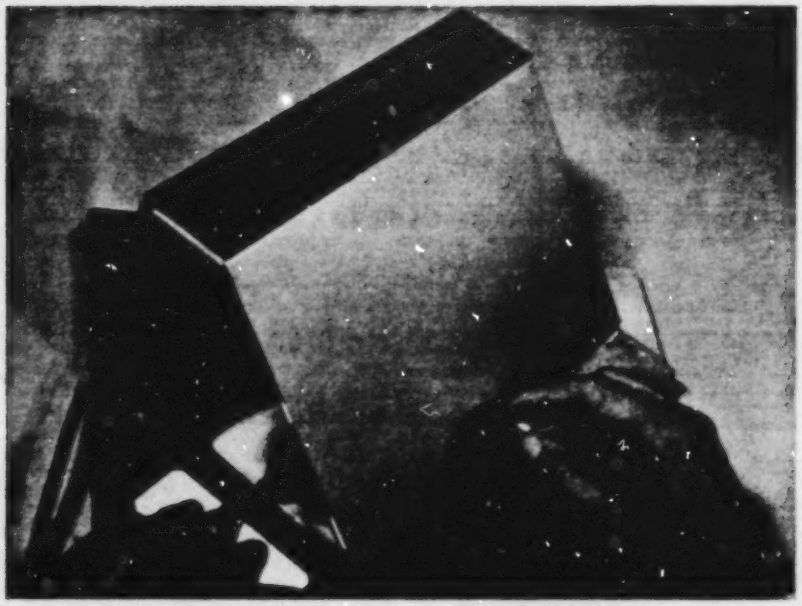
One hundred and twelve adolescents (45 females and 67 males) served as subjects in this study. The subjects were carefully screened to represent three distinct adolescent groups: moderately mentally retarded, mildly mentally retarded, and mentally normal. There were 39 adolescents in the moderate group, 36 in the mild group, and 37 in the normal group. All subjects were volunteers and were obtained from a youth camp and several schools and workshops in Central and Northern Indiana.

Procedure

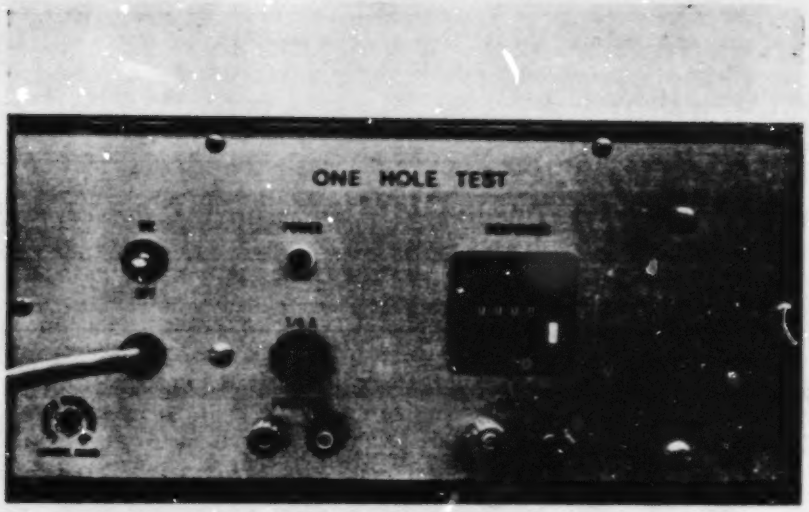
Three measures of sensorimotor learning ability were computed for each subject: inferred initial performance, sensorimotor learning rate, and predicted training time. Inferred initial performance was defined

as the subject's rate of improvement in sensorimotor performance during the testing. Predicted training time was defined as the estimated amount of time it would take the subject to reach a standard performance level.

The three measures of sensorimotor learning ability were computed from data collected with the Salvendy One-Hole Test (See Figure 1). The testing was done on an individual basis and involved performance of a peg positioning task over a series of 15 one-minute practice/observation trials. A learning curve was determined for each subject (see Figure 2). Regression analysis of the data yielded the three measures. The intercept of the regression line served as the measure of the subject's inferred initial performance. The slope of the regression line served as the measure of the subject's sensorimotor learning rate. The number of one-minute practice trials needed by the subject to reach a standard performance level was estimated using the regression equation, and the estimated served as the measure of the subject's predicted training time. The intellectual categories, normal, mildly mentally retarded, and moderately mentally retarded, served as the independent variable and the three sensorimotor learning abilities, inferred initial performance, sensorimotor learning rate, and predicted training time, served as the dependent variables.



(*a*)



(*b*)

Figure 1. The one-hole test: (a) test apparatus; (b) console control.

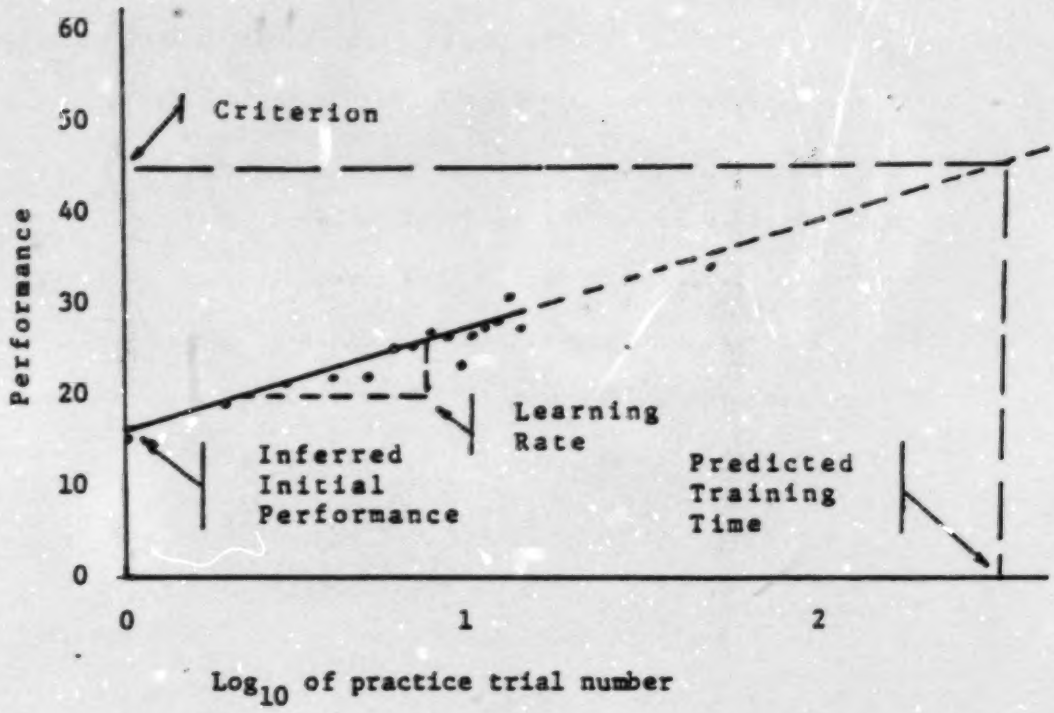


Figure 2. Typical Transformed Learning Curve for an Individual Subject.

One-way analysis of variance and Scheffe's post hoc test procedures were used to compare the sensorimotor learning abilities of the three subject groups. The procedures were repeated for each measure of sensorimotor learning ability.

Results and Discussion

The results of this study indicated that the mentally retarded and normal adolescents have different sensorimotor learning abilities on

two of the three components of the learning curve model of sensorimotor learning ability. See Table 1 for the means, standard deviation, and range of the three dependent variables for each intellectual category.

Inferred initial performance.

As expected, retarded subjects were found to have significantly lower inferred initial performance scores than normal subjects, $p < .001$ (see Table 2a). This result agrees with the findings of Ismail and O'Dwyer (1975) and Londeree and Johnson (1973) in which the performance of mentally retarded subjects was substantially below that of normal subjects.

A secondary analysis was performed using the method of discriminant analysis. Discriminant analysis operating on the variable inferred initial performance alone correctly classified 83 of the 112 subjects into their actual intellectual category. In addition, the analysis identified seven mildly mentally retarded and one moderately mentally retarded subjects whose inferred initial performance scores suggested that their motor aptitude was equivalent to those of the normal subject group. These results suggest that inferred initial performance might be useful as a sensorimotor adaptive measure that would permit, in some degree, confirmation of the diagnostic category or equally important identification of subjects with higher sensorimotor learning abilities than their intellectual category implies.

Table 1. Means, Standard Deviations, and Ranges of Sensorimotor Learning Variables for Normal and Retarded Categories.

Intellectual Category	n	Inferred Initial Ability[a]	Sensorimotor Learning Rate[b]	Predicted Training Time[c]
Normal	37	33.8/4.8 22.2-43.0	6.2/2.7 0.5-11.9	2.4/2.9 0.4-18.8
Mildly Mentally Retarded	36	24.1/5.8 12.0-34.6	5.8/2.7 1.3-12.7	4.5/2.9 1.6-15.4
Moderately Mentally Retarded	39	16.0/5.4 5.1-31.6	5.3/2.3 1.3-11.6	6.9/4.5 2.9-21.3
Overall Sample	112	24.5/9.1 5.1-43.0	5.7/2.6 0.5-12.7	4.6/4.0 0.4-21.3

Notes: The data are: $\frac{\text{mean/standard deviation}}{\text{range}}$

The scores on all variables have a theoretical lower limit of zero and no theoretical or practical upper limit.

[a] Units for inferred initial ability are pins per trial (i.e., pins per minute).

[b] Units for sensorimotor learning rate are Δpins per $\Delta\log_{10}$ trials.

[c] Unit for predicted training time is $\log_{10}$ trials.

Table 2. ANOVA Tables

a. ANOVA Table for Inferred Initial Performance by Intellectual Category.

Source	DF	MS	F	P
Between	2	3023.46	106.18	.0000
Within	109	28.47		
Total	111			

b. ANOVA Table for Sensorimotor Learning Rate by Intellectual Category.

Source	DF	MS	F	P
Between	2	14.56	1.126	.3281
Within	109	7.28		
Total	111			

c. ANOVA for Predicted Training Time by Intellectual Category.

Source	DF	MS	F	P
Between	2	191.26	14.95	.0000
Within	109	12.79		
Total	111			

Sensorimotor learning rate.

Mentally retarded subjects were not found to have a different sensiromotor learning rate than normal subjects, $p = .33$ (see Table 2b). This finding contradicts the opinion of MacMillan (1977) who believed that the retarded are inefficient sensorimotor learners. This surprising finding apparently had no antecedent in the research literature.

The finding that the mentally retarded subjects as a group may learn at the same rate as normals raises the challenging possibility that they may be able to learn a predominantly sensorimotor job as rapidly as normal subjects. A predominantly sensorimotor job is one that is relatively free of cognitive elements either by its nature or design.

The indication that mentally retarded subjects learn a sensorimotor job at the same rate as normals raises the question of whether mentally retarded learn a sensorimotor job by the same or different learning processes as normals. MacMillan (1977) believed that the mentally retarded learned by the same processes as normal individuals. If it can be determined that the mentally retarded learn by the same processes as normals, it would indicate the possibility that extensive effort investigating special training methods for mentally retarded students may be misdirected.

The distribution of sensorimotor learning rate scores was through an overall range of .5 to 12.7. This extensive range indicates that measurement of the learning rate of a subject could be an important consideration in selection of trainees of all intellectual categories for a training program or for employment.

Predicted training time.

As expected, retarded subjects were found to have significantly longer predicted training time than normal subjects, $p < .001$ (see Table 2c). This result was in agreement with the finding of differences in inferred initial performance but in apparent contradiction to the finding of no difference in sensorimotor learning rate between groups. The variable, predicted training time, was calculated on the learning curve model as the training time expected from the regression line (see Figure 2). The predicted training time was dependent in part on the constant, inferred initial performance, as well as the linear coefficient, sensorimotor learning rate. The result, predicted training time, should be interpreted in terms of these two dependencies. This dual dependency could be an explanation of why Ghiselli (1966) found low predictive validities in his survey of motor aptitude tests using only performance measures.

The learning curve model was used to estimate training time in this study but was not validated. It remains a logical but speculative method until testing of predicted training time to a criterion level can be accomplished.

These findings tend to suggest that while the mentally retarded as a group require more training than normal adolescents, there are numbers of identifiable mentally retarded youth whose predicted training time does not match their intellectual category and presents the possibility that some have a predicted training time approximating that of normal subjects.

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